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AN INNOVATIVE STUDY ON RECYCLING OF DEMOLISHED BUILDING WASTE IN CONCRETE FOR SUSTAINABLE DEVELOPMENT

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Abstract

The construction industry uses more resources and produces more waste than any other industrial sector; sustainable development depends on the reduction of both, while providing for a growing global population. The reuse of existing building components could support this goal. In this study, the fine aggregate used in concrete which is river sand and M. sand is been replaced with constructions and demolished waste is been used. For the proper proportion and use an appropriate mix design has been developed. The material used in the study is the construction and demolished waste i.e., the clay brick used in constructing partitions walls and parapet wall, this is being crushed and grained to obtain the size of a fine aggregate. This study, also includes the experimental details of comparison test between compressive strength of conventional concrete and replaced (C&D) concrete for the 7th,14 th,21st,28th and 56th days. The significance of the study is that the recycling of the construction and demolished waste could be converted be more useful that just using it as a land filling material with more yield of 5.46 N/mm^2 higher compared to conventional concrete.

Keywords:Recycled concrete waste, sustainable development, construction and demolished waste

1.0 INTRODUCTION

Central Pollution Control Board has estimated current quantum of solid waste generation in India to the tune of 48 million Tons per annum of which waste from Construction Industry accounts for 25%. Construction waste is bulky, heavy and is mostly unsuitable for disposal by incineration or composting. The growing population in the country and requirement of land for other uses has reduced the availability of land for waste disposal. Re-utilization or recycling is an important strategy for management of such waste. Above all, the fast depleting reserves of conventional natural aggregate has necessitated the use of recycling/ re-use technology in order to be able to conserve the conventional natural aggregate for other important works. Apart from mounting problems of waste management, other reasons which support adoption of reuse/ recycling strategy are reduced extraction of raw materials, reduced transportation cost, reduced capital investment on raw materials, improved profits and reduced environmental impact.

Construction by nature is not an eco-friendly activity. Construction, renovation and demolition activities lead to the formation of waste. Construction and demolition waste is generated whenever any construction/demolition activity takes place, such as, building roads, bridges, flyover, subway, remodeling etc. It consists mostly of inert and non-biodegradable material such as concrete, plaster, metal, wood, plastics etc. A part of this waste comes to the municipal stream. These wastes are heavy, having high density, often bulky and occupy considerable storage space either on the road or communal waste bin/container. It is not uncommon to see huge piles of such waste, which is heavy as well, stacked on roads especially in large projects, resulting in traffic congestion and disruption.

Waste from small generators like individual house construction or demolition, find its way into the nearby municipal bin/vat/waste storage depots, making the municipal waste heavy and degrading its quality for further treatment like composting or energy recovery.

Preservation of the environment and conservation of the rapidly diminishing natural resources should be the essence of sustainable development. So, recycling of Construction Waste is the need of the day.

Globally speaking, there is an evident need to recycle more and thus, reduce the amount of waste being disposed into landfills that are rapidly filling. The construction industry in particular is notorious for the creation of vast amounts of waste. It is only sensible that this industry should do more to develop new ways of bringing waste that can potentially be recycled back into the production line.

Demolition of old and deteriorated buildings and traffic infrastructure, and their substitution with new ones, is a frequent phenomenon today in a large part of the world. The main reasons for this situation are changes of purpose, structural deterioration, rearrangement of a city, expansion of traffic directions and increasing traffic load, natural disasters (earthquake, fire and flood), etc.

1.1 Scope of the Report

Reduce the environmental impact:

- Creates less pollution by reducing manufacturing and transportation-related emissions.
- Uses less energy and water compared to many product manufacturing processes.
- Reduces greenhouse gasses by using less energy for manufacturing and transportation.
- Reusing, reusing salvaged building materials and minimizing materials and packaging reduces waste disposal costs and material expenses.

1.2 Objectives

- To reuse the demolished building waste.
- To compute the strength of conventional concrete and concrete replaced with demolished waste.

2.0 IS MIX DESIGN FOR M20

It takes 1.5 cubic metre of total material to prepare one cubic of concrete,because cement and sand fills the gaps between the aggregate (crushed stone).

Ratio for M_{20} concrete is 1:1.5:3

1. Volume of cement needed = [ratio of cement/ratio (Cement+fine+coarse)]*Volume of raw material
   = [1/ (1+1.5+3)] *1.5
   = 0.273 cu.m
2. Volume of fine aggregate = [ratio of F.A/ratio (Cement+fine+coarse)]*Volume of raw material
   =1.5/ (1+1.5+3)] *1.5
   = 0.409cu.m
3. Volume of Aggregate needed = [ratio of C.A/ratio (Cement+fine+coarse) *Volume of raw material
   =3/ (1+1.5+3)] *1.5
   = 0.818cu.m
4. Volume of water = [mass of water /specific gravity] ×1/1000 = [192/1] ×1/1000= 0.192m^3

2.1 Selection of W/C ratio:

- Maximum w/c ratio = 0.45
- Based on experience adopted w/c ratio = 0.50

2.2 Weight of the Material's used

1. Cement = 2.73 kg
2. Fine aggregate (C&D waste) = 4.09 kg
3. Course aggregate = 8.18 kg
4. Water = 1.92 L

(The above-mentioned weight and amount are just for two cube moulds)

3.0 EXPERIMENTAL STUDY

3.1 Casting of Concrete Specimen

The cube moulds of dimensions 150x150x150 mm were used for casting the concrete cube for compressive strength. The test moulds are kept ready before preparing the concrete mix. The bolts of the moulds are tightened carefully by spanners in order to keep the concrete locked in the mould and to prevent the flowing of concrete. The moulds are well cleaned and oil applied on the contact surfaces of the moulds.

The concrete is also well mixed on the basis of the mix design and the fine aggregate is fully replaced with construction and demolished waste i.e., clay bricks form the C&D waste is been grained to the size of fine aggregate. The freshly prepared concrete is filled in the cubes by three layers and tampered by tampering rods for about 25 blows per layer. The top surface of the concrete is struck by using trowel and finished smoothly. Then the concrete is kept undisturbed for 24 hours for setting respectively. After 24 hours of casting the cubes are de-molded and kept inside the curing tank for further compressive strength tests.

3.2 Compressive Strength Tests of Concrete

The concrete cubes are tested by CTM(Compressive Testing Machine) of 2000KN capacity as per IS 516-1959. Tests were carried at 7, 14 and 28 days of curing. The concrete cube is kept under the CTM machine and then load is applied by operating the machine by giving the dimensions of the cube which is to be tested. The load is applied gradually till the concrete cube gets failed under a load.

Compressive Strength = P\A

Where, P=Ultimate Load in N
A=Area of cube in mm^2

4.0 RESULT OF LABORATORY INVESTIGATION

Table 1 & 2 shows the result of the compressive strength of the replaced concrete and compressive strength of the conventional concrete. The results were illustrated below.

Table 1 Result of the compressive strength of the replaced concrete

No of days	Peak Load (kN)	Area of Specimen (mm^2)	Compressive Strength (N/mm^2)
7	221.0	22500	9.82
14	298.34	22500	13.25
21	431.49	22500	19.17
28	593.34	22500	26.37
58	683.25	22500	30.36

Table 2 Result of the compressive strength of the conventional concrete

No of days	Peak Load (kN)	Area of Specimen (mm^2)	Compressive Strength (N/mm^2)
7	239.29	22500	10.63
14	310.73	22500	13.18
21	407.87	22500	18.12
28	472.13	22500	20.98
58	546.61	22500	24.29

5.0 GRAPHICAL REPRESENTATIONS

Fig. 1 and 2 shows the graphical representations of the conventional and replaced concrete's compressive strength.

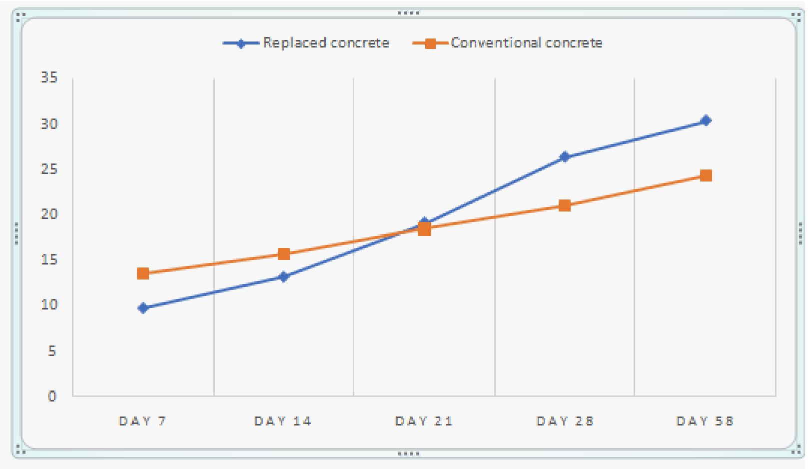

Fig. 1 Comparison for the conventional and replaced concrete

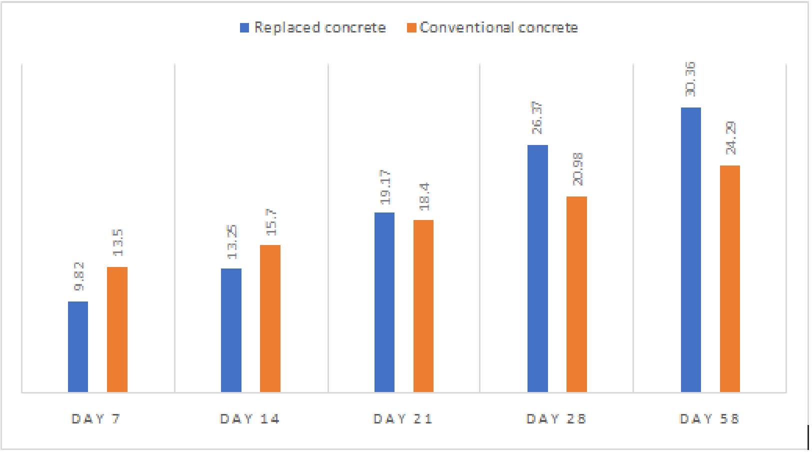

Fig. 2 Comparison of compressive strength of the conventional and replaced concrete

Fig. 1 and 2 shows the graphical representations of the conventional and replaced concrete's compressive strength.

CONCLUSION

This study has developed concepts for the reutilization of construction materials, including waste debris, by means of recycling into other components that are useful in construction. Primary opportunities identified in this study to divert Construction and Demolition bricks grains from the solid waste stream exist in the form of demolition operations to salvage or recycle building materials and systems. The compressive strength of the replaced concrete of 7th,14th,21st,28th and 56thdays is 9.82 N/mm^2,13.25N/mm^2, 19.17 N/mm^2, 26.37 N/mm^2 and 30.36N/mm^2 respectively with which the conclusion is proved that there is a phenomenal increase in strength of the concrete in comparing to the conventional concrete i.e., 7th, 14th, 21st, 28th and 56th days is 10.63 N/mm^2, 13.18 N/mm^2, 18.12 N/mm^2, 20.98 N/mm^2, 24.29N/mm^2 respectively. From this study, it is concluded that the C&D waste in the replacement to the fine aggregate which would reduce the use of natural resources like river sand and M. sand which is available in limited amount and also the replaced concrete isn't less strong than conventional concrete i.e., 5.47 N/mm^2 (25.69%) higher than the conventional concrete which gives the assurance it could be a liable procedure to reduce exploitation of natural resource.

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